ON A NEW METHOD OF INCREASING THE PRESSURE ON THE ARTERY IN THE USE OF THE SPHYGMOGRAPH.

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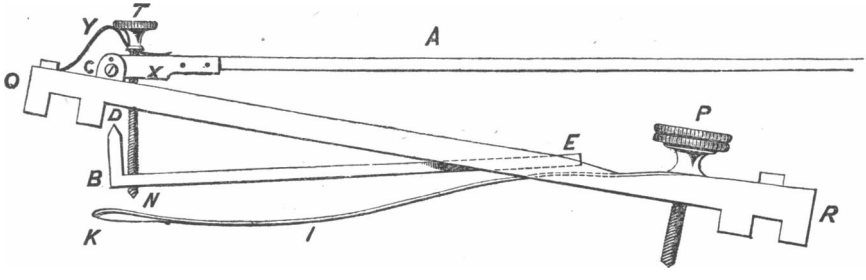
THE Sphygmograph in the hands of Wolff and others has yielded pulse traces much more complete in their details than those originally published by Marey. This satisfactory result has been obtained by attention to some minor points in the application of the instrument; which, as often happens, the followers of the inventor have had the good fortune to discover. In the present state of Sphygmography there is urgent need, that the mode of applying the instrument, and increasing the pressure on the vessel, should be clearly understood in order that reliable results may be obtained by the less experienced observers. In a brief note published in the *Medico-Chirurgical Review* for July last, I pointed out how we may measure the amount of pressure exercised on the artery by the descent of the tactile spring. In this communication I propose to suggest a second method by which pressure may be applied more readily and estimated more accurately. A brief reference to the plans adopted by Wolff and others will, however, most profitably precede the description of the arrangement to be proposed in this paper. The woodcut (fig. 1)[1], which shews the principal parts of Marey's sphygmograph, will aid the reader to understand these plans and to follow my remarks.

Fig. 1.



[1] For a full description of this figure see the author's little work *On the use of the Sphygmograph in the investigation of Disease*, pp. 10, 11.

In his excellent and laborious treatise (*Charakteristik des Arterienpulses*), Wolff tells us that he found the position of the writing lever AA' as regulated by the screw T, had considerable influence in developing the finer features of the pulse trace. When he turned the screw more than was necessary to bring the knife-edge D of the prop (DB) into contact with the lever at X, he discovered that he not only raised the writing point of the lever, but also exercised greater pressure on the artery. The traces collected with the lever writing high up exhibiting features which were greatly obscured, or altogether lost when the lever was low down. In the instrument used by Wolff, however, the little spring Y was much stronger than it is made in the instruments now sold; and it was found when the lever was very much elevated, that the spring Y in Wolff's sphygmograph, was strong enough to completely destroy the value of the trace. In fact, the friction developed between the knife-edge D and the under-surface of the lever at X, was sufficient to interfere with the free communication of the movement to the lever. The spring Y was therefore removed, and Wolff found that he could obtain his results without its assistance, as sufficient pressure was exerted by screwing down T so as to elevate the lever. For my own part I must confess that the elevation of the lever has not succeeded in any experiments until the influence of the little spring Y has begun to make itself felt. The springs now used are however so very delicate that they cannot develope nearly so much friction as the stronger spring used by Wolff. The pressure to be obtained by this application of the little spring in many cases is not nearly sufficient to develope the secondary waves in the pulse trace, and when the lever is raised very high every one can notice, even when the spring T is removed, that the friction at the point of the communication of the movement from D to X is much too great to allow of exact registration.

Dr Anstie, in his able report on Medicine in the *Biennial Retrospect* of the Sydenham Society, mentions in reference to this subject, another plan that Dr Sanderson and Dr Beigel have used with advantage. It consists in hanging a little weight on the writing lever A, which according to its position on the lever exercises through the knife-edge D varying

degrees of pressure on the artery[1]. Pressure can certainly be thus obtained, and the amount may be estimated with great nicety, but my experience of it is not satisfactory, and moreover it is open to the same strong objection urged against the first-mentioned plan. The friction between the points D and X is greatly increased, and a very small amount of weight on the lever suffices to suppress all the finer features of the pulse trace. In order therefore for any plan to be free from the objections just mentioned, the weight must act *directly* upon the tactile spring at its point of contact with the artery. The weight when thus placed compels the spring to follow closely each movement of the vessel, and does not allow a severance of the connection at any moment during the period of expansion, or, when it is more likely to occur, at the beginning of the period of collapse. In the screw T we have the only means of exerting this *direct* pressure, not indeed by using it as Wolff did, who obtained indirect pressure through the action of the lever on D, but by acting directly on the screw T itself, and therefore by its point N on the tactile spring immediately over the artery. With this end in view, I have had a series of small weights made to fit the head of the screw T, so that by changing them, or placing several on at a time, the weight can easily be adjusted to the requirements of each case. The pressure falls *directly* upon the tactile spring immediately over the artery, and no extra friction is produced at X. On the contrary, the tendency is in the opposite direction, and the value of the little spring Y in maintaining a close connection between D and the under-surface of the lever becomes very evident.

All who have worked with the sphygmograph will at once admit that the amount of pressure required varies very much in different cases and under different conditions. The weight which developes clearly all the secondary waves in a full-sized pulse of moderate tension, for example, oftentimes suffices to suppress the true form of a smaller pulse, or the same pulse under conditions of feeble tension. Indeed, in cases where the tension is very low the feeling spring has often to be weakened before a true record can be obtained, as Wolff and Anstie have pointed out. The weights which have proved most useful in

[1] A similar plan has been adopted in Baker's new sphygmograph.

my hands vary in size from 6 to 12 grammes, and are so made that any number can be applied at one time, each weight fitting on the one below. A weight of 30 grammes, or even more, can be thus used. Occasionally small weights of 2 to 4 grammes will be found useful.

In the pulse traces figured below (figs. 2, 3, 4) we can see at a glance, how the small secondary waves, and even the great diastolic wave, become more clearly defined under carefully adjusted pressure.

In the first two pulsations (fig. 2) we have the form registered on the simple application of the instrument. The first secondary wave (*a*), and the great diastolic wave (*b*), and the notches preceding these waves are moderately well seen.

Fig. 2.

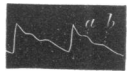


Fig. 3.

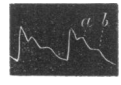
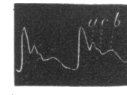


Fig. 4.



In the next tracing (fig. 3) we see these important features still better developed, and we remark the greater height of the line of ascent. In this case the pressure on the artery was produced by a weight of 16 grammes. In fig. 4, under a pressure of 26 grammes, the main features of the pulse trace have grown still more distinct, and gradually dawning on us, as it were, we see rising out of the great diastolic notch the second secondary wave *c*). Wolff has published similar forms obtained by his plan, but in cases where much pressure is required to develope all the features of a pulsation, no amount of lever elevation has sufficed in my experience to produce perfect traces. The use of the screw *P* for increasing the pressure on the artery should only be resorted to when very great pressure is needed, or when the artery is so deeply placed that the instrument as ordinarily applied cannot reach it. In the great majority of observations the amount of pressure available by the use of the weights recommended above will be found sufficient. The ease and rapidity of application, and the accuracy with which the pressure can be calculated, form the great advantages of the arrangement I have proposed; and as it necessitates no alteration in the instrument, and does not interfere with the elasticity of the spring, I trust others will soon confirm my opinion of its usefulness.